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TEST-RETEST SCORES FOR PATIENTS WHO DISPLAY NEUROPSYCHOLOGICAL IMPAIRMENT FOLLOWING "MILD HEAD INJURIES" FROM MECHANICAL IMPACTS[1]

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Summary.—A total of 20 patients who had sustained impact of significant mechanical energies to the skull (>40 km/hour) were assessed at Time 1, about one year (68% between 2 mo. and 12 mo.) postincident while Time 2 was about two years later. During Time 1 this group was impaired (proficiency $z < -2.00$) according to two standardized neuropsychological indices and exhibited abnormally elevated psychometric depression ($z > 2.00$). There were no statistically significant improvements for the scores between Times 1 and 2 on the Halstead-Reitan Impairment Index, the Memory Quotient, Depression, or an impairment index composed of standardized scores for 31 neuropsychological tests. These results indicated that the presumption of some neuropsychologists that patients with "mild head injury" have fully recovered within one year or will continue to improve after about one year following the incident may not be valid for all patients who sustain such brain trauma.

Empirical measurements by which we infer neuropsychological and psychological factors are the most objective criteria we have for the evaluation of standardized deficits and any changes in these deficits for patients who have sustained impacts of significant mechanical energies (usually during motor vehicle incidents) to the whole body. One of the most common claims by some neuropsychologists who assess insurance-referred patients is that the patient with "moderate neuropsychological impairment" (frequently labelled as mild head injury) either has recovered after one year or will continue to improve during the subsequent two years.

The present analyses were designed to discern if any clinically significant changes, defined as an effect size of at *least* equivalent to one-third of the variance ($\eta = .57$), occurred for 20 patients who were tested twice. Although the sample was small, the required effect size would not only be statistically significant but would be above the perceptual threshold for detection by clinical observation and within the range that has daily practical consequences for patients. This group of patients had the potential to display quantitative changes psychometrically because they had displayed moderate neuropsychological impairment; hence they could either improve or become worse.

The mean and standard deviation for the ages of the 10 men and 10 women were 33 and 11 years, respectively. All patients had been referred by professional agencies (during the lasts four years) because there were difficulties with postincident adaptation in either vocational or family settings after a significant impact of mechanical energy (most patients had been in a stationary automobile that had been struck by another) to the skull (of the patients 80% had suspended consciousness for at least 30 min.; 50% were unconscious for 2 or more hours). The means and standard deviations for the time between the mechanical impact to the skull and the first assessment and between the first assessment and second assessment were 1.0 ($SD = 0.8$) yr. (range 0.2 to 3.8 yr.; 68% of them within 12 mo.) and 1.8 ($SD = 1.2$) yr. (range 0.8 to 5.2 yr.).

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Each patient was administered the same battery of tests in the same order (which required 8 hr. over two days).

The seven primary measurements made were the Halstead-Reitan Impairment Index (2), the Laurentian Neuropsychological Impairment Index composed of the average of 31 standardized test scores that included the tasks from the Halstead-Reitan Index as well as, for example, dichotic word listening, conditioned spatial association, verbal and design fluency (1), the Wechsler Adult Intelligence Scale–Revised Verbal IQ, Performance IQ, and Memory Quotient (MQ), and the depression (D) and eccentric thinking (Sc) scores from the MMPI–168 (3). All MMPI profiles were valid according to the three validity scales.

The average standardized score of the Reading, Spelling and Arithmetic components for the Wide Range of Achievement Test Revised–2 (WRAT–R), an inference of educational achievement, was used as a "control" measure for each patient. t ratios were calculated for mean test-retest scores on each of the seven tests. Repeated-measures analyses of variance were completed after the shared variance with the latency between the incident and Time 1 assessment or assessments at Times 1 and 2 or age was first removed statistically to discern the internal consistency (coefficient alpha) of the scores. The 31 z-transformed measures of our index were completed for Times 1 and 2. Scattergrams were employed to examine characteristics of the distributions. All analyses involved SPSS software.

The test-retest scores, with the exception of the Halstead-Reitan Indices were analyzed as z scores. The means and standard deviations for the eight measures at Times 1 and 2, the t ratios ($t > 2.25$, $p < .05$) for the differences between the means, and the test-retest correlations ($r > .50$, $p < .01$) are shown in Table 1. The coefficients alpha for the 31 z-score measures of the Laurentian Impairment Index for Times 1 and 2 were .56 and .78.

TABLE 1

MEANS AND STANDARD DEVIATIONS ON z SCORES FOR VARIOUS MEASURES AT TIMES 1 AND 2 WITH t RATIOS AND CORRELATIONS

Measure	Time 1		Time 2		t	r
	M	SD	M	SD		
Laurentian Impairment Index	−2.8	1.2	−2.6	1.1	< 1.00	66
WAIS–R Verbal IQ	−1.0	0.4	−0.9	0.4	1.95	81
WAIS–R Performance IQ	−1.2	0.5	−0.9	0.5	2.36	60
Memory Quotient	−0.7	0.8	−0.7	0.8	< 1.00	.72
Educational Achievement	−1.0	0.8	−0.9	0.8	< 1.00	.91
Depression	2.3	1.0	2.4	1.4	< 1.00	.53
Eccentric Thinking	0.5	0.8	0.4	1.4	< 1.00	.30
Halstead-Reitan Index (0 to 1)*	0.7	0.2	0.7	0.2	< 1.00	.46

*Raw scores.

The magnitudes of Friedman's nonparametric correlations did not differ appreciably from the parametric values. The means and standard deviations for the discrepancies between the z scores for the Laurentian Impairment Index (average of the 31 measures) and z scores for the average of WAIS–R Verbal IQ and Performance IQ at Time 1 were −1.8 and 1.1 and at Time 2 were −1.8 and 1.0 ($t < 1.00$). The negative values indicated that on the average, the neuropsychological scores were 1.8 standard deviations below the patients' intellectual levels. The t ratio indicated that this discrepancy had not changed between Times 1 and 2.

The possibility that the performance by these patients may have reached asymptote was examined by completing nonparametric correlations between the test scores and the time in months between the injury and the first assessment. Because 68% of the patients were tested

within one year and 42% were tested between 2 mo. and 8 mo. after the injury, we estimated that any significant cross-sectional change during the first year might be seen; the limits of this inference from cross-sectional analysis were appreciated. Only 3 of the 31 neuropsychological measures displayed a statistically significant correlation with time. Scores for Trials A (*rho* = .51), left foot agility (−.49), and left finger agility (−.51) were more impaired as a function of time between the injury and the assessment. There was also no statistically significant association between time and score for Depression (*rho* = .04) or eccentric thinking (*rho* = −.20) over time. Consequently there was no cross-sectional suggestion of "change" or "recovery" in this sample.

Initial removal by using partial correlations of the variance associated with the time between the incident and the first assessment or between assessments at Times 1 and 2 (all *df*s = 1.19) did not alter the statistical significance of the mean differences between pairs of scores for these patients (all *F*s < 1.00). Because our data involved averages for the 20 patients rather than individual variations of each patient, we examined the individual ranges of change for each patient. Our two most sensitive predictors of postinjury adaptability are the Laurentian Neuropsychological Index and the MMPI Depression scale. The differences between the scores at two assessments were calculated.

The numbers of patients for whom a change in scores was within the absolute value of 1 standard deviation were 12 and 13, respectively, for the Laurentian Neuropsychological Index and the MMPI Depression scale. The numbers of patients whose scores worsened more than 1.0 *SD* were 3 and 2, respectively, while the numbers of patients who improved above 1.0 *SD*s were 5 and 5, respectively. Chi-squared analyses, however, based upon expected distributions of 68%, 16%, and 16% of a population for a normal distribution showed that the empirical distributions did not differ from the expected values (*df* = 2, all values < 3.00). Even doubling this sample's size would not have given statistically significant values.

Present results indicated that these patients who exhibited moderate (proficiency $z < -2.00$) neuropsychological impairments subsequent to mechanical impacts to the skull and who were diagnosed as a "mild head injury" (because of the brief unconsciousness) or "no head injury" by some classical neurological criteria, do not improve significantly between approximately the first and second years after the injury. If we assume that the numerical characteristics of an appropriate sample of patients from a cross-sectional analysis reflects the numerical characteristics of a longitudinal analysis for a smaller subset of patients, then these data would predict that the patients in our study were not improving but may have scored worse on some tasks.

Consequently caution, particularly when recommendations and conclusions are provided to insurance companies operating within restricted time frames, should be emphasized in neuropsychological reports because these patients may *not* "continue to improve." The fact that the standardized scores were still within the impaired range, despite average intelligence and educational achievement, offers the strongest evidence that these patients had not recovered. Interestingly, we noted that after the first year many patients "felt" as if they had recovered even though the standardized, norm-referenced tests indicated otherwise.

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